Preliminary Estimates of Protected Species Bycatch Rates in the U.S. Atlantic Pelagic Longline Fishery from 1 January – 31 March 2008

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Background

The U.S. Atlantic Pelagic Longline fleet operates along the U.S. coast from the Gulf of Mexico to New England, the waters of the Caribbean, and in international waters of the western and central North Atlantic Ocean. Quarterly reporting of interactions with protected species, including marine turtles and marine mammals, was required by the 30 June 2004 Biological Opinion. The goal of this measure was to more closely monitor any potential short-term increases in interaction rates and thereby allow a more responsive management program. This report meets this requirement and includes the observed fishery effort and incidental takes reported by the Pelagic Observer Program (POP) from 1 January 2008 through 31 March 2008.

During quarter 1 of 2008, a cooperative research program was begun with NOVA Southeastern University inside areas normally closed to pelagic longlining in the Florida East Coast (FEC) and the South Atlantic Bight (SAB) fishing areas. Two vessels carried out experimental fishing operations using standardized gear; with the goal of, to the extent possible, conducting roughly equal amounts of fishing effort inside and outside the closed areas during the same trip. The collected data will be used to compare catch and bycatch rates between closed and open areas, as well as testing the efficacy of circle hooks in bycatch reduction inside the closed areas, where longline operations have not taken place since before the implementation of circle hooks throughout the fishery. Experimental fishing effort was 100% observed.

While it would be desirable to directly estimate the absolute level of takes (i.e. the total number of turtles or mammals estimated to be taken by the fishery), fishery effort data are reported on logbook forms by fishing captains, and current data are therefore not available until several months after the end of any given quarter. As a result, the bycatch rate (i.e. catch per unit effort) presented here is based solely on observer data as an indicator of the relative level of interactions with protected species. The observed bycatch rate by fishing area during quarter 1 of 2008 is compared to that observed in quarter 1 of 2007 and to the average of the previous five years (2003-2007) for quarter 1 to assess whether or not the

observed rate in 2008 was unusually high or low. Bycatch rates were calculated by applying the delta log-normal method using hooks as the unit of effort. The analytical methods were described in detail in Garrison (2003).

Results and Discussion

A total of 186 longline sets (149,902 hooks*)* were observed during quarter 1 of 2008 (Table 1A) during normal fishing operations, with only circle hooks (sizes 16/0 and 18/0) recorded. The majority of the normal fishing observed sets occurred in the Gulf of Mexico (GOM) area (Figures 1 and 2, Table 1). The experimental fishery included an additional 12 sets inside the FEC and SAB closed areas that are classified as experimental effort (5,830 hooks) (Figure 3, Table 1B).

The locations of observed sets and turtle interactions during normal fishing operations are shown in Figure 1. During normal fishing operations, there were 8 observed interactions with leatherback turtles (3 in the FEC area, 4 in the GOM area, and one in the Tuna North (TUN) area) and 1 observed interaction with loggerhead turtles in the FEC area (Table 2A). All turtles were released alive. All 8 of the leatherbacks were hooked, two of which were also entangled (Appendix A1). The one loggerhead was hooked but not entangled upon capture (Appendix A1B).

Concerted efforts by fishers to remove hooks and disentangle captured turtles are mandated by the Biological Opinion in order to reduce post-hooking mortality, and the fishers' performance is monitored. Specific information on injuries to sea turtles and gear characteristics of each interaction are shown in Appendix A. Of the 8 leatherback turtles known to be hooked, all were hooked in the shoulder, armpit, or front flipper (Appendix A1A). Hooks were removed from 5 of these leatherbacks; the line remaining on the remaining 3 was less than 0.1 feet. Of the 2 leatherbacks reported entangled at capture, both were disentangled when released.

Two additional leatherback interactions were observed during experimental fishing operations (Table 2B, Figure 3, Appendix A2A), where one leatherback was hooked in the armpit and the hook and gear was removed prior to release, while one leatherback was hooked in an unknown location and released with 6 feet of line attached. Neither of these leatherbacks was entangled upon capture.

The one loggerhead was hooked in the shoulder, but not entangled upon capture, the hook was removed, and this turtle was released with no trailing gear (Appendix A1B).

There was one observed interaction with a marine mammal, which occurred in the GOM area, observed during normal fishing operations during quarter 1 (Table 3, Figure 2). This interaction was with a Risso's dolphin, the fluke of which was wrapped in line upon capture. The line parted upon haul back, and the animal was released with 6 feet of gear, but was presumed dead as it floated away with its head out of water.

The quarterly and regional bycatch rates during normal fishing operations are summarized for marine turtles in Table 4 and for marine mammals in Table 5. These rates were compared with those from the same quarter/area for 2007 and the average for the first quarter/area from 2003-2007 in Tables 6 and 7 (Fairfield-Walsh and Garrison, 2007). Specific information on injuries to sea turtles and gear characteristics of each interaction are shown in Appendix A1.

For leatherback turtles, the bycatch rates during normal fishing operations in the FEC was slightly elevated in comparison to the 2007 bycatch rates (Table 6A), as well as the five year average rates. In the GOM area, the bycatch rate during this quarter was significantly higher than the zero bycatch rate for 2007, but was consistent with that observed during 2003-2007. The bycatch rate in the TUN area was significantly greater than that observed during 2003-2007, when no bycatch was observed in this area. In the South Atlantic Bight (SAB) area, there were no observed catches of leatherbacks during 2007 and 2008, which is a significant reduction relative to the 2003-2007 average rate in this area. There was no observer coverage for the other areas during this quarter of 2008 in any of the other previously observed fishing areas.

For loggerhead turtles, the bycatch rate observed in the FEC area was similar to that observed during 2007 as well as the average 2003-2007 bycatch rate (Table 6B). The zero bycatch rate in the GOM area was consistent with that observed in 2007, and significantly lower than the average 2003-2007 bycatch rate. In the SAB, no loggerheads were observed as bycatch during this quarter of 2008, which is a significant reduction relative to the 2007 and the average 2003-2007 bycatch rates. No loggerheads were observed caught in the TUN area, which was similar to the average 2003-2007 rate. There was no observer coverage during normal fishing operations for the other areas in which bycatch rates for turtles have been observed during the past five years.

The bycatch rate of Risso's dolphins in the GOM area was significantly higher than both the zero bycatch rate observed for this species in 2007, as well as the average 2003-2007 bycatch rate, as indicated by the non-overlapping 95% confidence intervals (Table 7). No bottlenose dolphins were observed taken in the SAB area, which was consistent with the 2007 observations, but was a significant reduction relative to the 2003-2007 average bycatch rate for this area. Similarly, no unidentified dolphins were observed taken in the GOM area during this quarter in 2008, similar to 2007, which was a significant reduction relative to the average 2003-2007 bycatch rate. There was no observer coverage during normal fishing operations for the other areas in which bycatch rates for marine mammals have been observed during the past five years.

There are a number of caveats and uncertainties associated with the current analysis. First, while these data have undergone an initial audit and review, they are subject to change upon further review after the end of the 2008 calendar year when all logbook data are available. Second, the delta log-normal estimator was applied to calculate bycatch rates

consistent with previous estimates (e.g., Garrison 2003). This approach assumed 1) that catch rates (animals per hook) were log-normally distributed, and 2) that the number of hooks was an appropriate unit of effort. The first assumption has been evaluated for turtles; however, violations of this assumption may have resulted in biased (positive or negative) estimates of catch rate and associated variances. The second assumption has not been examined critically in previous analyses. If this assumption was not correct, for example if there were saturation effects resulting in a non-linear relationship between the number of hooks and total catch, then there potentially may have been a bias in the estimate of bycatch rates.

The interaction between longline gear and protected species is a relatively rare event and is therefore inherently variable. Historically, there have been very large inter-annual fluctuations in bycatch rates and estimates of total bycatch. Thus, any differences observed between short term observations of bycatch rates and long term averages may be simply stochastic events and are not necessarily indicative of a significant change in the interactions between the longline fishery and protected species.

Literature Cited

Fairfield-Walsh, C. 2007. Preliminary Estimates of Protected Species Bycatch Rates in the U.S. Atlantic Pelagic Longline Fishery between 1 January and 31 March 2007; SEFSC Document #PRD-06/07-04; 13 p.

Garrison, L.P. 2003. Estimated Bycatch of Marine Mammals and Turtles in the U.S. Atlantic Pelagic Longline Fleet During 2001-2002. NOAA Technical Memorandum NOAA NMFS-SEFSC-515: 52 p.

Table 1. The number of sets and hooks observed in the U.S. Atlantic Pelagic Longline Fishery from 1 January – 31 March 2008 is shown by fishing area during (A) Normal and (B) Experimental fishing operations. Areas with missing values indicate there was no observer coverage during this time period in this area.

A. Normal Fishing Operations

Area	# Sets	# Hooks
CAR	-	-
FEC	38	25,951
GOM	130	106,701
MAB	-	-
NCA	-	-
NEC	-	-
NED	-	-
SAB	8	6,030
SAR	-	-
TUN	10	11,220
TUS	-	-
Total	**186**	**149,902**

B. Experimental Fishing Operations

Area	# Sets	# Hooks
CAR	-	-
FEC	5	2,330
GOM	-	-
MAB	-	-
NCA	-	-
NEC	-	-
NED	-	-
SAB	7	3,500
SAR	-	-
TUN	-	-
TUS	-	-
Total	**12**	**5,830**

Table 2. Interactions with marine turtles observed during 1 January – 31 March 2008 in the U.S. Atlantic Pelagic Longline Fishery, shown by fishing area during (a) Normal and (b) Experimental fishing operations. Areas with missing values (dashes) indicate there was no observer coverage during this time period in this area.

A. Normal Fishing Operations

Area	Leatherback Takes Observed	Loggerhead Takes Observed
CAR	-	-
FEC	3	1
GOM	4	0
MAB	-	-
NCA	-	-
NEC	-	-
NED	-	-
SAB	0	0
SAR	-	-
TUN	1	0
TUS	-	-
Total	8	1

B. Experimental Fishing Operations

Area	Leatherback Takes Observed	Loggerhead Takes Observed
CAR	-	-
FEC	1	0
GOM	-	-
MAB	-	-
NCA	-	-
NEC	-	-
NED	-	-
SAB	1	0
SAR	-	-
TUN	-	-
TUS	-	-
Total	2	0

Table 3. Interactions with marine mammals observed during 1 January – 31 March 2008 in the U.S. Atlantic Pelagic Longline Fishery, shown by fishing area during normal fishing operations. Observer comments and criteria described in Angliss and DeMaster (1998) were used to evaluate serious injury.

Species	Area	# Released Uninjured	# Serious Injury	# Dead
Risso's Dolphin	GOM	0	0	1

Table 4. Estimated bycatch rate (Catch per unit effort (CPUE) = catch per 1000 hooks) for (A) Leatherback, and (B) Loggerhead turtles by area during 1 January – 31 March 2008 in the U.S. Atlantic Pelagic Longline Fishery during normal fishing operations. Missing values (dashes) indicate areas with no observer coverage. "Var CPUE" indicates the variance of the catch per unit effort, and "CV" indicates the coefficient of variation of the estimated rate.

A. Leatherback Turtles

Area	Type of Injury	Number of Turtles	Observed Sets	# Positive Sets	Mean CPUE	Var CPUE	CV
CAR	-	-	-	-	-	-	-
FEC	Alive	3	38	3	0.1143	0.0043	0.5721
GOM	Alive	4	130	4	0.0330	0.0003	0.4958
MAB	-	-	-	-	-	-	-
NCA	-	-	-	-	-	-	-
NEC	-	-	-	-	-	-	-
NED	-	-	-	-	-	-	-
SAB	Alive	0	8	0	0	-	-
SAR	-	-	-	-	-	-	-
TUN	Alive	1	10	1	0.0952	0.0091	1.0000
TUS	-	-	-	-	-	-	-

Table 4 (cont.)

B. Loggerhead Turtles

Area	Type of Injury	Number of Turtles	Observed Sets	# Positive Sets	Mean CPUE	Var CPUE	CV
CAR	-	-	-	-	-	-	-
FEC	Alive	1	38	1	0.0537	0.0029	1.0000
GOM	Alive	0	130	0	0	-	-
MAB	-	-	-	-	-	-	-
NCA	-	-	-	-	-	-	-
NEC	-	-	-	-	-	-	-
NED	-	-	-	-	-	-	-
SAB	Alive	0	8	0	0	-	-
SAR	-	-	-	-	-	-	-
TUN	Alive	0	10	0	0	-	-
TUS	-	-	-	-	-	-	-

Table 5. Estimated bycatch rate (Catch per unit effort (CPUE) = catch per 1000 hooks) for marine mammals by area during 1 January – 31 March 2008 in the U.S. Atlantic Pelagic Longline Fishery during normal fishing operations. Missing values (dashes) indicate areas with no observer coverage. Under "Type of Injury", "Alive" indicates the animal was released alive uninjured, and "SI" indicates the animal was released alive with a serious injury, based on observer comments and criteria described in Angliss and DeMaster (1998). "Var CPUE" indicates the variance of the catch per unit effort, and "CV" indicates the coefficient of variation of the estimated rate.

Species	Type of Injury	Number of Animals	Area	# Positive Sets	# Observed Sets	Mean CPUE	Var CPUE	CV
Risso's Dolphin	Dead	1	GOM	1	130	0.0087	0.0001	1.0000

Table 6. The bycatch rates are shown for (A) Leatherback turtles, and (B) Loggerhead turtles in the U.S. Atlantic longline fishery during 1 January - 31 March 2008 during normal fishing operations, in comparison to 2007 and to the average rate from 2003-2007. "95% CI" indicates the estimated 95% confidence interval of the mean bycatch rate (CPUE) in each cell assuming a log-normal distribution of rates. CPUEs reflect total turtles caught including alive and dead turtles.

A. Leatherback Turtles

Area	2008 CPUE	2008 95% CI	2007 CPUE	2007 95% CI	2003-2007 CPUE	2003-2007 95% CI
CAR	-	-	0	-	0.0326	0.0067 – 0.1591
FEC	0.1143	0.0414 – 0.3150	0.0521	0.0107 – 0.2546	0.1603	0.0915 – 0.2809
GOM	0.0330	0.0135 – 0.0807	0	-	0.0783	0.0518 – 0.1184
MAB	-	-	0	-	0.0160	0.0033 – 0.0781
NCA	-	-	-	-	0	-
NEC	-	-	-	-	0	-
NED[1]	-	-	-	-	0	-
SAB	0	-	0	-	0.2529	0.1056 – 0.6059
SAR	-	-	0	-	0.0968	0.0486 – 0.1930
TUN	0.0952	0.0195 – 0.4656	-	-	0	-
TUS	-	-	-	-	0	-

[1]Fishery effort in the NED region during 2003 (included in this table) followed an experimental design distinct from "normal" fishery operations.

Table 6 (cont.)

B. Loggerhead Turtles

Area	2008 CPUE	2008 95% CI	2007 CPUE	2007 95% CI	2003-2007 CPUE	2003-2007 95% CI
CAR	-	-	0.3949	0.0808 – 1.9306	0.2712	0.1553 – 0.4734
FEC	0.0537	0.0110 – 0.2625	0.0833	0.0254 – 0.2731	0.2283	0.1395 – 0.3736
GOM	0	-	0	-	0.0091	0.0033 – 0.0253
MAB	-	-	0	-	0.0306	0.0092 – 0.L1025
NCA	-	-	-	-	0.2125	0.0719 – 0.6279
NEC	-	-	-	-	0	-
NED[1]	-	-	-	-	0	-
SAB	0	-	0.2252	0.0871 - 5825	0.1643	0.0683 – 0.3950
SAR	-	-	0	-	0.3916	0.2502 – 0.6129
TUN	0	-	-	-	0	-
TUS	-	-	-	-	0	-

[1]Fishery effort in the NED region during 2003 (included in this table) followed an experimental design distinct from "normal" fishery operations.

Table 7. The summary of bycatch rates for marine mammals in the U.S. Atlantic longline fishery during 1 January – 31 March 2008 during normal fishing operations, in comparison to rates from the previous year (2007) and the average of the previous five years (2003-2007). "95% CI" indicates the estimated 95% confidence interval of the mean bycatch rate (CPUE) in each cell assuming a log-normal distribution of rates. CPUEs reflect total marine mammals caught including alive, dead, and seriously injured animals.

Species	Area	2008 CPUE	2008 95% CI	2007 CPUE	2007 95% CI	2003-2007 CPUE	2003-2007 95% CI
Beaked Whale	CAR	-	-	0	-	0.0476	0.0097 – 0.2328
Beaked Whale	SAR	-	-	0	-	0.0221	0.0045 – 0.1080
Bottlenose Dolphin	SAB	0	-	0	-	0.0041	0.0045 – 0.1080
Pilot Whale	CAR	-	-	0	-	0.0531	0.0160 – 0.1763
Pilot Whale	MAB	-	-	0	-	0.2361	0.1115 – 0.4998
Risso's Dolphin	GOM	0.0087	0.0018 – 0.0427	0	-	0.0041	0.0008 – 0.0200
Unid. Dolphin	GOM	0	-	0	-	0.0041	0.0008 – 0.0201

Figure 1. The observed U.S. Pelagic Longline Fishery effort and marine turtle interactions during 1 January – 31 March 2008 during normal fishing operations are shown. The pelagic longline fishing areas in the North Atlantic Ocean are as follows:
CAR = Caribbean, GOM = Gulf of Mexico, FEC = Florida East Coast, SAB = South Atlantic Bight, SAR = Sargasso Sea, MAB = Mid-Atlantic Bight, NEC = Northeast Coastal, NED = Northeast Distant, NCA = North Central Atlantic, TUN = Tuna North and TUS = Tuna South. Area closures and the U.S. Exclusive Economic Zone (EEZ) are shown.

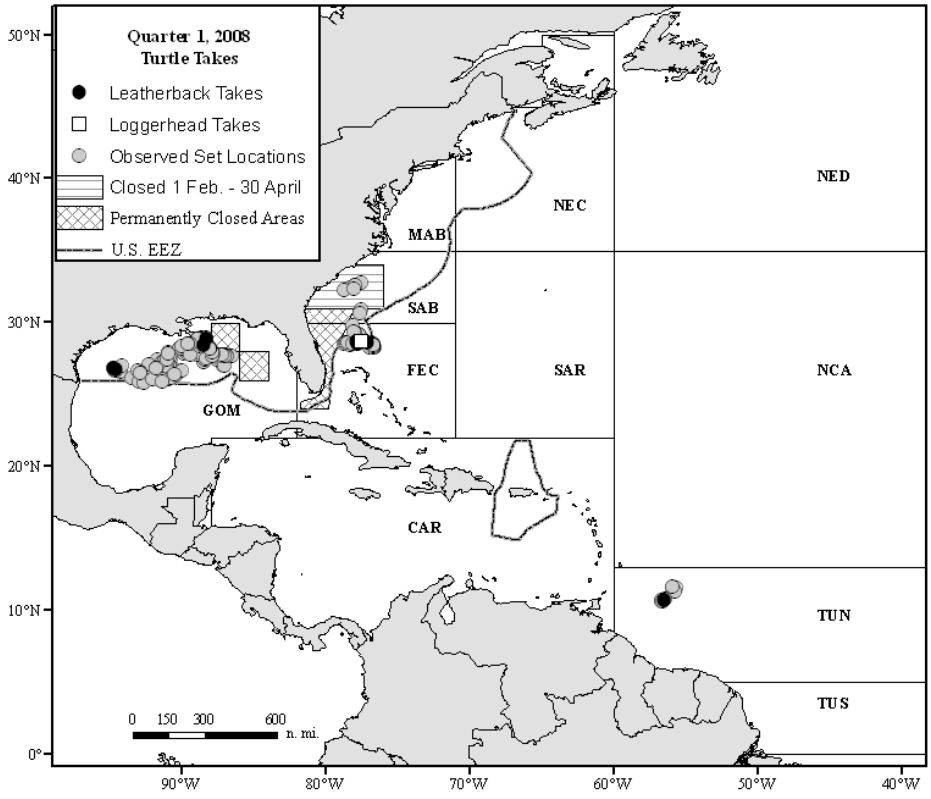


Figure 2. The observed U.S. Pelagic Longline Fishery effort and marine mammal interactions during 1 January – 31 March 2008 during normal fishing operations are shown. The pelagic longline fishing areas in the North Atlantic Ocean are as follows: CAR = Caribbean, GOM = Gulf of Mexico, FEC = Florida East Coast, SAB = South Atlantic Bight, SAR = Sargasso Sea, MAB = Mid-Atlantic Bight, NEC = Northeast Coastal, NED = Northeast Distant, NCA = North Central Atlantic, TUN = Tuna North and TUS = Tuna South. Area closures and the U.S. Exclusive Economic Zone (EEZ) are shown.

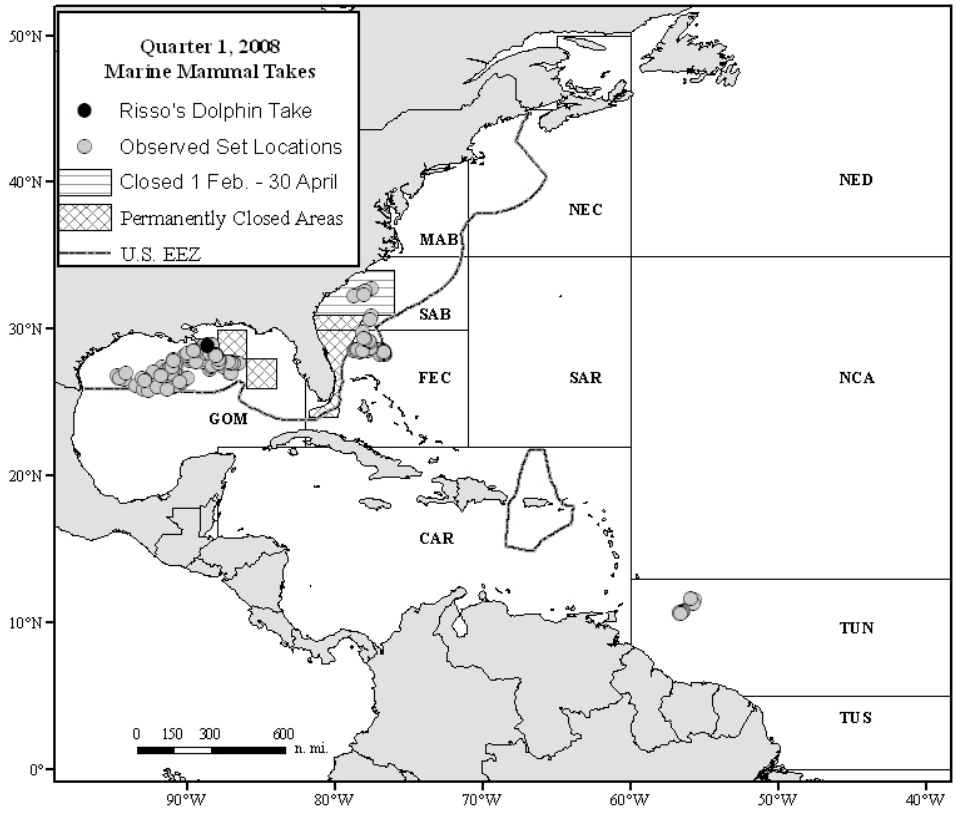
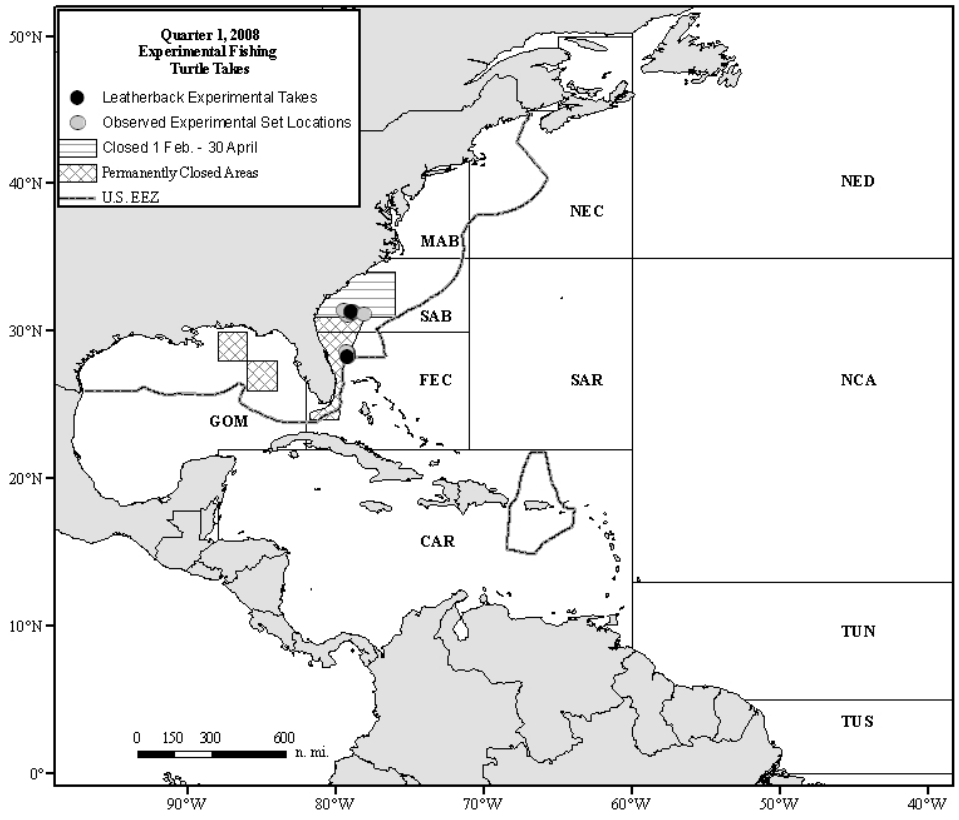


Figure 3. The observed U.S. Pelagic Longline Fishery effort and marine turtle interactions during 1 January – 31 March 2008 during experimental fishing operations are shown. The pelagic longline fishing areas in the North Atlantic Ocean are as follows:
CAR = Caribbean, GOM = Gulf of Mexico, FEC = Florida East Coast, SAB = South Atlantic Bight, SAR = Sargasso Sea, MAB = Mid-Atlantic Bight, NEC = Northeast Coastal, NED = Northeast Distant, NCA = North Central Atlantic, TUN = Tuna North and TUS = Tuna South. Area closures and the U.S. Exclusive Economic Zone (EEZ) are shown.



Appendix A1: Injury details and hook types for turtles captured in the U.S. Atlantic Pelagic Longline Fishery during 1 January – 31 March 2008 during normal fishing operations. "CL Est." indicates an estimated carapace length in feet; "CCL" indicates a measured curved carapace length in cm; and "Straight N-N" indicates a straight line measurement of the turtle carapace from notch to notch.

A. Leatherback Turtles

#	Species	Area	Hook Type	Offset (degrees)	Bait	Bait Size (g)	Capture Condition	Final Disposition	Hook Location	Hook Removed?	Entangled Capture?	Entangled Release?	Line Left (ft)	CL Est. (ft)	CCL (cm)	Straight N-N (cm)
1	Leatherback	GOM	C-16/0	0	squid	324	Alive, injured	Released alive	front flipper	Yes	Yes	No	0.00	4.00		
2	Leatherback	FEC	C-18/0	10	squid	187	Alive, injured	Released alive	front flipper	Yes	No	No	0.00	4.50		
3	Leatherback	FEC	C-18/0	10	squid	160	Alive, injured	Released alive	front flipper	Yes	Yes	No	0.00	5.00		
4	Leatherback	TUN	C-16/0	0	squid	191	Alive, injured	Released alive	armpit	No	No	No	0.10	4.50		
5	Leatherback	FEC	C-18/0	10	squid or mackerel	338 or 192	Alive, injured	Released alive	shoulder	Yes	No	No	0.00	5.00		
6	Leatherback	GOM	C-16/0	0	squid	198	Alive, injured	Released alive	shoulder	No	No	No	0.10	4.00		
7	Leatherback	GOM	C-16/0	0	squid	198	Alive, injured	Released alive	armpit	No	No	No	0.00	4.00		
8	Leatherback	GOM	C-16/0	0	squid	149	Alive, injured	Released alive	armpit	Yes	No	No	0.00	4.00		

Appendix A1 (cont.):

B. Loggerhead Turtles

#	Species	Area	Hook Type	Offset (degrees)	Bait	Bait Size (g)	Capture Condition	Final Disposition	Hook Location	Hook Removed?	Entangled Capture?	Entangled Release?	Line Left (ft)	CL Est. (ft)	CCL (cm)	Straight N-N (cm)
1	Loggerhead	FEC	C-18/0	0	squid	300	Alive, injured	Released alive	shoulder	Yes	No	No	0.00	3.50		

Appendix A2: Injury details and hook types for turtles captured in the U.S. Atlantic Pelagic Longline Fishery during 1 January – 31 March 2008 during experimental fishing operations. "CL Est." indicates an estimated carapace length in feet; "CCL" indicates a measured curved carapace length in cm; and "Straight N-N" indicates a straight line measurement of the turtle carapace from notch to notch.

A. Leatherback Turtles

#	Species	Area	Hook Type	Offset (degrees)	Bait	Bait Size (g)	Capture Condition	Final Disposition	Hook Location	Hook Removed?	Entangled Capture?	Entangled Release?	Line Left (ft)	CL Est. (ft)	CCL (cm)	Straight N-N (cm)
1	Leatherback	FEC	C-18/0	0	squid	300	Alive, injured	Released alive	unknown	No	No	No	6.00	5.00		
2	Leatherback	SAB	C-18/0	0	mackerel	272	Alive, injured	Released alive	armpit	Yes	No	No	0.00	5.00		